APPENDIX I

PRELIMINARY ECOLOGICAL RISK ASSESSMENT

TECHNICAL MEMORANDUM

PRELIMINARY ECOLOGICAL RISK ASSESSMENT FOR THE OLD TOXIC TRAINING AREA, PARCEL 188(7)

FORT McCLELLAN
CALHOUN COUNTY, ALABAMA

This Technical Memorandum presents the Preliminary Ecological Risk Assessment (PERA) for the Old Toxic Training Area (Parcel 188[7]) at Fort McClellan (FTMC) located in Calhoun County, Alabama. The PERA approach is a shortened version of the Screening-Level Ecological Risk Assessment (SLERA) protocol which has been developed for FTMC as a means to evaluate numerous sites in a uniform and economical way. It is assumed that the reader is familiar with FTMC and the fundamentals of the SLERA protocol presented in the Installation-Wide Work Plan (IT Corporation (IT), 1998). Each step of the PERA is described in the following sections.

Ecological Habitat Description. The Old Toxic Training Area is approximately 0.95 acres in size and is located in the west central area of FTMC Main Post. The site is relatively flat, with a gentle slope to the north and west. The site is bounded on the north and west by paved roads, and on the east and south by narrow wooded areas. The northern portion of the site is covered with an asphalt parking area that covers approximately one-quarter of the entire site. The remaining area of the site is vegetated with loblolly (*Pinus taeda*) and shortleaf pine (*Pinus echinata*). Understory and shrub species are typically sparse in this type of habitat. A mat of pine needles generally inhibits the growth of shrub and herbaceous layers within this forest type. As stated previously, this site is within the Main Post of FTMC and as such, the area surrounding the site has been significantly developed and ecological habitat is limited to those habitats characteristic of developed areas (i.e., maintained lawns, ornamental trees and plants, etc.). Typical terrestrial species inhabiting this type of habitat include cottontail rabbit (*Sylvilagus floridanus*), eastern gray squirrel (*Sciurus carolinensis*), whitetail deer (*Odocoileus virginianus*), wild turkey (*Meleagris gallopavo*), shorttail shrew (*Blarina brevicauda*), red fox (*Vulpes vulpes*), white-footed mouse (*Peromyscus leucopus*), American robin (*Turdus migratorius*), and red-tailed hawk (*Buteo jamaicensis*).

Media of Interest and Data Selection. The medium of interest at the Old Toxic Training Area is surface soil. There are no surface water bodies associated with the Old Toxic Training Area; therefore, surface water and sediment were not collected at this site. Additionally, exposures to sub-surface soil and groundwater are unlikely for ecological receptors at the Old Toxic Training Area. Therefore, surface soil is the only medium of interest at this site. Four surface soil samples were collected and analyzed for metals, volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), and chemical warfare material (CWM) breakdown products.

Identification of Constituents of Potential Ecological Concern. In order to determine whether constituents detected in surface soil samples collected at the Old Toxic Training Area have the potential to pose adverse ecological risks, screening-level hazard quotients were developed. The screening-level hazard quotients were developed via a three-step process as follows:

- Comparison to Ecological Screening Values (ESVs);
- Identification of essential macro-nutrients; and
- Comparison to naturally-occurring background concentrations.

The ecological screening values (ESV) used in this assessment represent the most conservative values available from various literature sources and have been selected to be protective of the

most sensitive ecological assessment endpoints. These ESVs have been developed specifically for FTMC in conjunction with U.S. Environmental Protection Agency (EPA) Region IV and are presented in the *Final Human Health and Ecological Screening Values and PAH Background Summary Report* (IT, 2000c). The ESVs used in this assessment are based on no-observed-adverse-effect-levels (NOAEL) when available. If a NOAEL-based ESV was not available for a certain constituent, then the most health-protective value available from the scientific literature was used in this assessment.

Constituents that were detected in surface soil at the Old Toxic Training Area were evaluated against the ESVs by calculating a screening-level hazard quotient (HQ_{screen}) for each constituent. An HQ_{screen} was calculated by dividing the maximum detected constituent concentration in surface soil by its corresponding ESV as follows:

$$HQ_{screen} = \frac{MDCC}{ESV}$$

where:

HQ_{screen}	=	screening-level hazard quotient;
$MDCC$	=	maximum detected constituent concentration; and
ESV	=	ecological screening value.

A calculated HQ_{screen} value of one indicated that the MDCC was equal to the chemical's conservative ESV and was interpreted in this assessment as a constituent that does not pose the potential for adverse ecological risk. An HQ_{screen} value less than one indicated that the MDCC was less than the conservative ESV and that the chemical is not likely to pose adverse ecological hazards to most receptors. Conversely, an HQ_{screen} value greater than one indicated that the MDCC was greater than the ESV and that the chemical might pose adverse ecological hazards to one or more receptors.

In order to better understand the potential risks posed by chemical constituents at the Old Toxic Training Area, a mean hazard quotient was also calculated by comparing the arithmetic mean constituent concentration in surface soil to the corresponding ESV. The calculated screening-level hazard quotients for constituents in surface soil at the Old Toxic Training Area are presented in Table 1.

The EPA recognizes several constituents in abiotic media that are necessary to maintain normal function in many organisms. These essential macro-nutrients are iron, magnesium, calcium, potassium, and sodium (EPA, 1989). Most organisms have mechanisms designed to regulate nutrient fluxes within their systems; therefore, these nutrients are generally only toxic at very high concentrations. Essential macro-nutrients were considered COPECs only if they were present in site samples at concentrations ten times the naturally-occurring background concentration.

A study of the natural geochemical composition associated with FTMC (SAIC, 1998) determined the mean concentrations of 24 metals in surface soil, surface water, and sediment

samples collected from presumably unimpacted areas. Per agreement with EPA Region IV, the background threshold value (BTV) for each metal was calculated as two times the mean background concentration for that metal. The BTV for each metal was used to represent the upper boundary of the range of natural background concentrations expected at FTMC and was used as the basis for evaluating metals concentrations measured in site samples.

In order to determine whether metals detected in site samples were the result of site-related activities or were indicative of naturally occurring conditions, the maximum metal concentrations measured in site samples were compared to the corresponding BTVs. Site sample metals concentrations less than or equal to the corresponding BTV represent the natural geochemical composition of media at FTMC, and not contamination associated with site activity. Site sample metals concentrations greater than the corresponding BTV represent contaminants that may be the result of site-related activities and require further assessment.

Thus, the first step in determining screening-level hazard quotients was a comparison of maximum detected constituent concentrations to appropriate ESVs. Constituents with HQ_{screen} values less than one were considered to pose insignificant ecological risk and were eliminated from further consideration. Constituents with HQ_{screen} values greater than one were eliminated from further consideration if they were macro-nutrients. Those constituents that had HQ_{screen} values greater than one and were not considered macro-nutrients were then compared to their corresponding BTVs. If constituent concentrations were determined to be less than their naturally occurring background concentration, then a risk management decision could result in eliminating these constituents from further assessment. If a constituent was detected in surface soil at a maximum concentration that exceeded its ESV, was not an essential macro-nutrient, and was greater than the naturally-occurring levels at FTMC, then it was identified as a constituent of potential ecological concern (COPEC).

The COPECs that have been identified in surface soil at the Old Toxic Training Area are presented in Table 1 and are summarized below:

- aluminum
- arsenic
- beryllium
- copper
- selenium
- zinc
- 2-methylnaphthalene
- naphthalene
- 1,2,4-trimethylbenzene
- 1,2-dimethylbenzene
- 1,3,5-trimethylbenzene
- cumene
- ethylbenzene
- toluene
- n-butylbenzene
- n-propylbenzene
- p-cymene
- sec-butylbenzene

Ecological Risk Characterization. A number of constituents in surface soil were identified as COPECs; thus, they have the potential to pose ecological risk to one or more ecological receptor groups. However, there are several mitigating factors that should be taken into account when making a risk management decision for this site. The only sample that exhibited COPEC concentrations greater than the respective ESVs was CWM-188-MW01. No COPECs were identified at any of the other sample locations. Therefore, it can be concluded

that the surface soil contamination at this site is limited in its areal extent. Additionally, a number of constituents (namely; 2-methylnaphthalene, cumene, n-butylbenzene, n-propylbenzene, p-cymene, and sec-butylbenzene) were identified as COPECs solely because no ESVs exist for these particular compounds. Definitive statements about the potential for these constituents to pose ecological risks cannot be made at this time.

Several COPECs have screening level hazard quotients (HQ_{screen}) that only slightly exceed unity (arsenic $HQ_{screen} = 1.69$, beryllium $HQ_{screen} = 1.05$, copper $HQ_{screen} = 1.67$, selenium $HQ_{screen} = 4.85$, and zinc $HQ_{screen} = 1.05$). Taking into account the fact that the ESV is a highly conservative screening value based on no observed adverse effects and the HQ_{screen} is calculated using the maximum detected constituent concentration at the site, these inorganic constituents could be excluded from the list of COPECs.

Aluminum is a common element in native soils whose concentration varies over a wide range. The concentrations of aluminum detected in surface soil at the Old Toxic Training Area are all within the range of background concentrations of aluminum at FTMC. Additionally, a review of the site history of the Old Toxic Training Area did not indicate that aluminum was ever used or released to the environment at this site. Therefore, it could be concluded that aluminum is not a COPEC at this site.

There does appear to be a localized area of surface soil (in the vicinity of CWM-188-MW01) contaminated with volatile organic compounds (e.g. 1,2,4-trimethylbenzene, 1,2-dimethylbenzene, 1,3,5-trimethylbenzene, ethylbenzene, naphthalene, and toluene). Although larger animals with relatively large home ranges and foraging habits would not be expected to be adversely affected by this localized area of contamination, species with small home ranges living or feeding in the vicinity of the soil contamination could experience adverse effects from the contaminants in the surface soil at the Old Toxic Training Area.

Table 1

Constituents of Potential Ecological Concern in Surface Soil
Old Toxic Training Area, Parcel 188(7)
Fort McClellan, Calhoun County, Alabama

Detected Constituents	Upper Background Range[a] (mg/kg)	Background Threshold Value[b] (mg/kg)	Ecological Screening Value[c] (mg/kg)	Maximum Detected Conc. (mg/kg)	Minimum Detected Conc. (mg/kg)	Mean Detected Conc. (mg/kg)	Frequency of Detection	Maximum Hazard Quotient	Mean Hazard Quotient	Constituent of Potential Ecological Concern
METALS :										
Aluminum	3.99E+04	1.63E+04	5.00E+01	3.24E+04	1.19E+04	2.24E+04	4 / 4	6.48E+02	4.48E+02	YES
Arsenic	4.90E+01	1.37E+01	1.00E+01	1.69E+01	5.14E+00	9.40E+00	4 / 4	1.69E+00	9.40E-01	YES
Barium	2.88E+02	1.24E+02	1.65E+02	1.63E+02	7.54E+01	1.23E+02	4 / 4	9.88E-01	7.47E-01	1
Beryllium	8.70E-01	8.00E-01	1.10E+00	1.16E+00	4.48E-01	7.39E-01	4 / 4	1.05E+00	6.72E-01	YES
Calcium	1.79E+04	1.72E+03	NA	1.14E+04	2.00E+02	4.93E+03	4 / 4	ND	ND	2
Chromium	1.34E+02	3.70E+01	4.00E-01	3.22E+01	2.04E+01	2.56E+01	4 / 4	8.05E+01	6.39E+01	3
Cobalt	7.10E+01	1.52E+01	2.00E+01	6.88E+00	1.56E+00	4.59E+00	4 / 4	3.44E-01	2.29E-01	1, 3
Copper	2.40E+01	1.27E+01	4.00E+01	6.67E+01	8.69E+00	3.07E+01	4 / 4	1.67E+00	7.66E-01	YES
Iron	5.63E+04	3.42E+04	2.00E+02	5.98E+04	1.56E+04	3.16E+04	4 / 4	2.99E+02	1.58E+02	2
Lead	8.30E+01	4.01E+01	5.00E+01	2.70E+01	1.11E+01	1.63E+01	4 / 4	5.40E-01	3.26E-01	1, 3
Magnesium	9.60E+03	1.03E+03	4.40E+05	7.14E+03	9.17E+02	3.71E+03	4 / 4	1.62E-02	8.44E-03	1, 2
Manganese	6.85E+03	1.58E+03	1.00E+02	2.11E+02	1.89E+01	1.19E+02	4 / 4	2.11E+00	1.19E+00	3
Mercury	3.20E-01	8.00E-02	1.00E-01	4.00E+00	1.50E-02	3.43E-02	2 / 4	4.00E+01	3.43E-01	3
Nickel	2.20E+01	1.03E+01	3.00E+01	2.80E+01	8.06E+00	1.49E+01	4 / 4	9.33E-01	4.96E-01	1
Potassium	6.01E+03	8.00E+02	NA	3.78E+03	8.72E+02	1.75E+03	4 / 4	ND	ND	2
Selenium	1.30E+00	4.80E-01	8.10E-01	3.93E+00	5.51E-01	1.92E+00	4 / 4	4.85E+00	2.36E+00	YES
Sodium	5.63E+02	6.34E+02	NA	1.19E+02	5.00E-01	6.65E+01	3 / 4	ND	ND	2, 3
Vanadium	1.58E+02	5.88E+01	2.00E+00	7.31E+01	3.70E+01	5.36E+01	4 / 4	3.66E+01	2.68E+01	1
Zinc	2.09E+02	4.06E+01	5.00E+01	5.27E+01	1.78E+01	3.89E+01	4 / 4	1.05E+00	7.77E-01	YES
SEMIVOLATILE ORGANIC COMPOUNDS :										
2-Methylnaphthalene	NA	NA	NA	1.50E+01	3.00E-03	3.75E+00	1 / 4	ND	ND	YES
Acenaphthene	NA	7.02E-01	2.00E+01	9.50E-02	3.00E-03	2.60E-02	1 / 4	4.75E-03	1.30E-03	1, 3
Anthracene	NA	9.35E-01	1.00E-01	1.10E-01	3.00E-03	2.98E-02	1 / 4	1.10E+00	2.98E-01	3
Benzo(a)anthracene	NA	1.19E+00	5.21E+00	3.30E-01	3.00E-03	8.48E-02	1 / 4	6.33E-02	1.63E-02	1, 3
Benzo(a)pyrene	NA	1.42E+00	1.00E-01	3.00E-01	3.00E-03	7.73E-02	1 / 4	3.00E+00	7.73E-01	3
Benzo(b)fluoranthene	NA	1.66E+00	5.98E+01	4.30E-01	3.00E-03	1.10E-01	1 / 4	7.19E-03	1.84E-03	1, 3
Benzo(ghi)perylene	NA	9.55E-01	1.19E+02	2.40E-01	3.00E-03	6.23E-02	1 / 4	2.02E-03	5.23E-04	1, 3
Benzo(k)fluoranthene	NA	1.45E+00	1.48E+02	1.40E-01	3.00E-03	3.73E-02	1 / 4	9.46E-04	2.52E-04	1, 3
Carbazole	NA	NA	NA	8.40E-02	3.00E-03	2.33E-02	1 / 4	ND	ND	5
Chrysene	NA	1.40E+00	4.73E+00	3.00E-01	3.00E-03	7.73E-02	1 / 4	6.34E-02	1.63E-02	1, 3
Dibenz(a,h)anthracene	NA	7.20E-01	1.84E+01	6.00E-02	3.00E-03	1.73E-02	1 / 4	3.26E-03	9.38E-04	1, 3
Fluoranthene	NA	2.03E+00	1.00E-01	7.70E-01	3.00E-03	1.95E-01	1 / 4	7.70E+00	1.95E+00	3
Indeno(1,2,3-cd)pyrene	NA	9.37E-01	1.09E+02	2.40E-01	3.00E-03	6.23E-02	1 / 4	2.20E-03	5.71E-04	1, 3
Naphthalene	NA	3.30E-02	1.00E-01	8.80E+00	3.00E-03	2.20E+00	1 / 4	8.80E+01	2.20E+01	YES
Phenanthrene	NA	1.08E+00	1.00E-01	4.80E-01	3.00E-03	1.22E-01	1 / 4	4.80E+00	1.22E+00	3
Pyrene	NA	1.63E+00	1.00E-01	5.60E-01	3.00E-03	1.42E-01	1 / 4	5.60E+00	1.42E+00	3

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Detected Constituents	Upper Background Range[a] (mg/kg)	Background Threshold Value[b] (mg/kg)	Ecological Screening Value[c] (mg/kg)	Maximum Detected Conc. (mg/kg)	Minimum Detected Conc. (mg/kg)	Mean Detected Conc. (mg/kg)	Frequency of Detection	Maximum Hazard Quotient	Mean Hazard Quotient	Constituent of Potential Ecological Concern
VOLATILE ORGANIC COMPOUNDS :										
1,2,4-Trimethylbenzene	NA	NA	1.00E-01	3.30E+02	3.00E-03	8.25E+01	1 / 4	3.30E+03	8.25E+02	YES
1,2-Dimethylbenzene	NA	NA	5.00E-02	8.00E+01	3.00E-03	2.00E+01	1 / 4	1.60E+03	4.00E+02	YES
1,3,5-Trimethylbenzene	NA	NA	1.00E-01	1.10E+02	3.00E-03	2.75E+01	1 / 4	1.10E+03	2.75E+02	YES
2-Butanone	NA	NA	8.96E+01	1.70E-02	3.00E-03	7.67E-03	1 / 4	1.90E-04	8.56E-05	1
4-Methyl-2-pentanone	NA	NA	4.43E+02	5.40E-03	3.00E-03	3.80E-03	1 / 4	1.22E-05	8.58E-06	1
Acetone	NA	NA	2.50E+00	6.10E-01	1.40E-02	1.67E-01	4 / 4	2.44E-01	6.69E-02	1
Cumene	NA	NA	NA	1.20E+01	3.00E-03	3.00E+00	1 / 4	ND	ND	YES
Ethylbenzene	NA	NA	5.00E-02	4.00E+01	3.00E-03	1.00E+01	1 / 4	8.00E+02	2.00E+02	YES
Naphthalene	NA	3.30E-02	1.00E-01	5.50E+01	3.00E-03	1.38E+01	1 / 4	5.50E+02	1.38E+02	YES
Toluene	NA	NA	5.00E-02	2.60E+00	2.00E-03	6.52E-01	2 / 4	5.20E+01	1.30E+01	YES
n-Butylbenzene	NA	NA	NA	2.80E+01	3.00E-03	7.00E+00	1 / 4	ND	ND	YES
n-Propylbenzene	NA	NA	NA	5.30E+01	3.00E-03	1.33E+01	1 / 4	ND	ND	YES
p-Cymene	NA	NA	NA	4.50E+00	3.00E-03	1.13E+00	2 / 4	ND	ND	YES
sec-Butylbenzene	NA	NA	NA	8.20E+00	3.00E-03	2.05E+00	1 / 4	ND	ND	YES

[a] Upper background range as given in Science Applications International Corporation (SAIC), 1998. *Final Background Metals Survey Report, Fort McClellan, Alabama, July.*

[b] Background threshold value is two times (2x) the arithmetic mean of background metals (SAIC, 1998). For SVOCs, the BTV is the background screening value for soils adjacent to asphalt as given in IT Corporation (IT), 2000, *Final Human Health and Ecological Screening Values and PAH Background Summary Report, Fort McClellan, Calhoun County, Alabama*, July.

NA - Not available.

ND - Not determined.

Rationale for exclusion as a COPEC:

1 - maximum detected concentration less than ESV

2 - essential macro-nutrient

3 - maximum detected concentration less than BTV

4 - no ESV available, maximum detected concentration less than ESV for similar compounds